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JAMES RIVER BASIN WATER QUALITY STUDY

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JAMES RIVER BASIN

WATER QUALITY STUDY

1973

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JAMES RIVER BASIN

WATER QUALITY STUDY

1973

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E.P.A. Region III
Philadelphia, Pennsylvania

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Chapter I - Introduction

A. Request

The Air and Water Programs Division has requested the Surveillance and Analysis Division to investigate and evaluate the existing water quality of portions of the James River Basin.

B. Objectives

1. Establish a base-line record of water quality for the James River Basin.
2. Determination of characteristics and rates of natural purification of the James River Basin.
3. Determination of pollution downstream from major waste discharges.
4. Provide data to Enforcement Division for permit evaluation.

C. Acknowledgement of Aid and Assistance

During the course of this investigation it was necessary to obtain data and information from various sources. We are indeed grateful for the aid given and wish to express our appreciation to the Geological Survey (Department of the Interior) and the Environmental Protection Agency's Charlottesville Technical Support Laboratory for providing field sampling and field laboratory personnel and analysis of samples necessary to complete this investigation, especially to James LaBuy, Aquatic Biologist who prepared the section on biological quality.

Chapter II

DESCRIPTION OF STUDY AREA

The James River Basin is an irregular, tapering area extending in a southeasterly direction from the West Virginia State line, through the central portion of Virginia, to Hampton Roads at the mouth of the Chesapeake Bay. All or parts of 38 counties in Virginia, plus a portion of one county in West Virginia, are included in the James Basin. Bounding the James are the Potomac, Rappahannock, and York River Basins on the north; Ohio on the West; Roanoke and Chowan Basins on the south; and Chesapeake Bay on the east.

The James River has its source in the Allegheny Mountains and drains an area of 10,060 square miles in West Virginia. (Figure 1.) the James flows southeasterly past Richmond, then into the Chesapeake Bay at Hampton Roads. The largest tributaries are the Jackson and Cowpasture Rivers, which join to form the James River; the Maury, Buffalo, and Rivanna Rivers from the north; with Appomattox River entering from the south. Principal tributaries are listed in Table I on page . Total stream length (confluence Jackson-Cowpasture Rivers to Hampton Roads) is 339.7 miles, with a fall of 988 feet. Below the Fall Zone at Richmond, the James becomes as estuary.

Portions of four physiographic regions make up the James Basin: Valley and Ridge Province, Blue Ridge Province, Piedmont Plateau, and the Coastal Plain. A fifth region, the Allegheny Plateau, adjoins the Watershed on the west. Climate within the James Basin is mild, with yearly averages of temperature around 56°F, and rainfall about 42 incles. More temperate weather with slightly higher yearly precipitation occurs near the mouth of the James, because of the moderating effects of Chesapeake Bay and the Atlantic Ocean.

TABLE I

Principal Tributaries of the James River

Principal Tributaries of the James River	Miles from Confluence to Mouth of James River	Drainage Area Square Miles
Mames River	--	10,060
Chickahominy River	41.5	468
Appomattox River	71.6	1,610
Rivanna River	162.1	777
Buffalo River	213.8	413
Pedlar River	264.1	102
Maury River	279.7	837
Craig Creek	323.7	374
Jackson River	339.7	907
Cowpasture River	339.7	460

LOCATION MAP

JAMES RIVER BASIN
CHESAPEAKE DRAINAGE AREA

WATER QUALITY STUDY

U.S. ENVIRONMENTAL PROTECTION AGENCY
MIDDLE ATLANTIC REGION
REGION III PHILADELPHIA, PA.

FIGURE 1

(9)

Chapter III

Study Methodolgy

A. Time Period of Study

The investigation was started in May 1973. The field work was completed in October 1973, and all laboratory analysis, except the biological, was completed in December 1973. The biological analysis was completed in March 1974.

B. Sampling and Analytical Methods:

All sampling and analysis were performed in accordance with either "Standard Methods for the Examination of Water and Wastewater", Thirteenth Edition, or the Environmental Protection Agency "Methods for Chemical Analysis of Water and Wastes", (1971 Edition), or the Environmental Protection Agency "Biological Field and Laboratory Methods", (July, 1973 Edition). The laboratory facilities facilities were supplied by the Environmental Protection Agency Technical Support Laboratory at Charlottesville, Virginia.

C. Hydrological Methods:

Stream flow data was obtained from the U. S. Geological Survey.

ANALYSIS

B.O.D. (2 day, 5 day, 10 day, 20 day, 28 day, 40 day)

Total Organic Carbon

Chemical Oxygen Demand

Dissolved Oxygen

Water Temperature

Flow (at USGS Gaging Stations)

pH

Alkalinity/Acidity

Color/Turbidity

Specific Conductance

Total Solids

Total Suspended Solids

Total Dissolved Solids

Chloride

Sulfate

Hardness

Nitrite and Nitrate

Ammonia

Total Kjeldahl Nitrogen

Organic Nitrogen

Total Phosphorus

Ortho Phosphorus

Heavy Metals-Iron, Chromium, Zinc, Manganese, Copper

Mercury and Nickel

Tannins and lignins

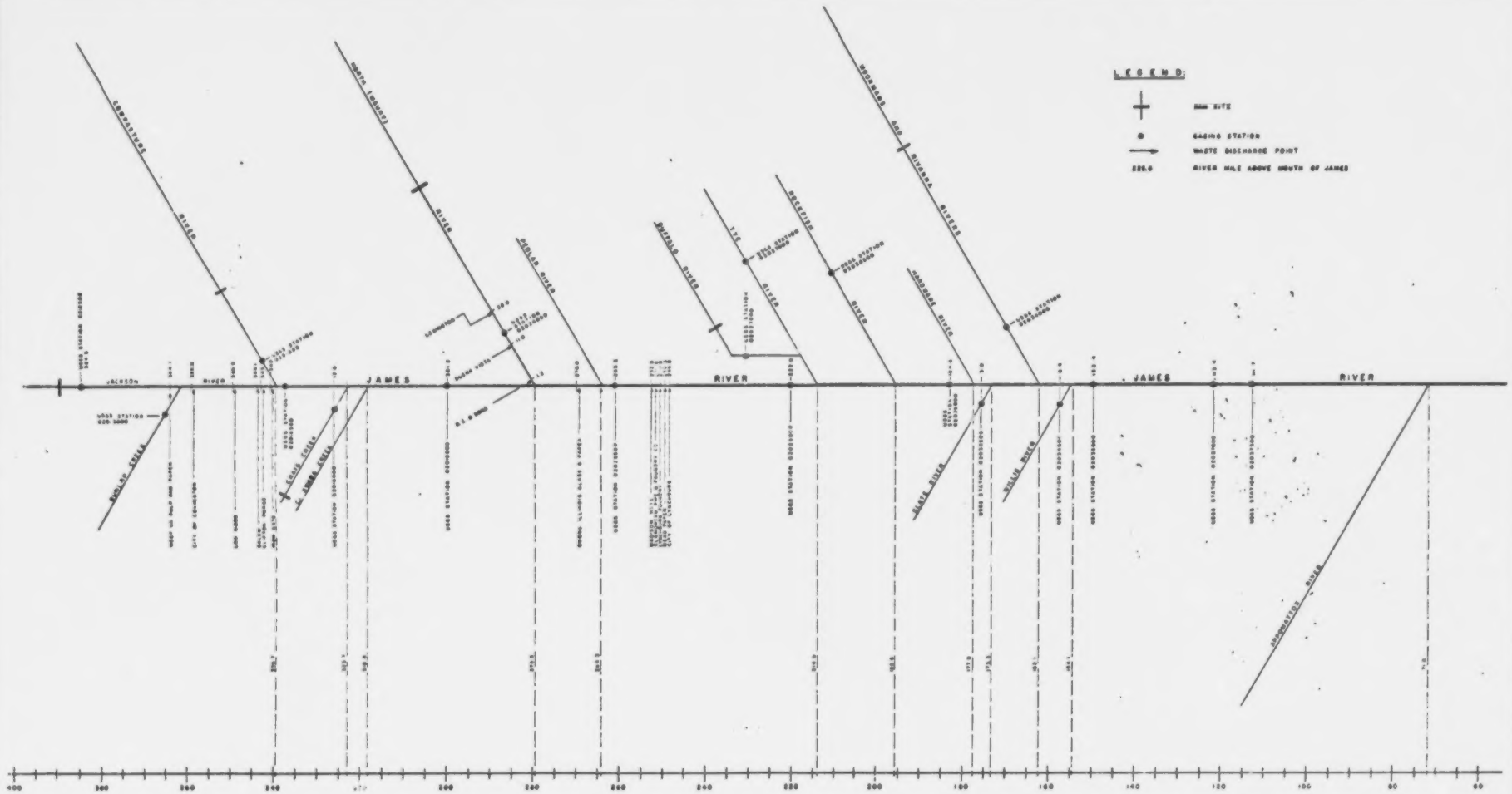
Benthic organisms

Chlorophyll a, b and c

Total Coliform

Fecal Coliform

Fecal Streptoccocus



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JAMES RIVER BASIN
CHESAPEAKE DRAINAGE AREA

LOCATION OF WASTE LOAD DISCHARGES & TRIBUTARIES

U.S. ENVIRONMENTAL PROTECTION AGENCY
MIDDLE ATLANTIC REGION
REGION III PHILADELPHIA, PA.

FIGURE 2

Sampling Stations

A. Section I.

Station No.	Basin	River Mile	Description
1.	Jackson River	35.8	Bridge on County Route 721 near Falling Springs, Va. (USGS Gage 02012500)
2.	Jackson River	25.6	City of Covington Water Treatment Plant Intake. Off US Route 220 @ Rivermont, Va.
3.	Jackson River	24.3	West Va. Co. Corp Treatment Plant outfall @ Covington, Va.
4.	Dunlap Creek (Jackson River	4.2 23.8)	Bridge on US Route 60 near Humback Bridge Wayside, Va. (near Intersection with County Route 600 (USGS gage 02013000)
5.	Jackson River	22.6	Bridge on Jackson Street, Covington, Va.
6.	Jackson River	21.0	Bridge on South Raymon Drive near Hercules Inc. Plant, Covington, Va.
7.	Jackson River	19.1	City of Covington Municipal waste-water treatment plant outfall. West Park St. off South Munford Ave., Covington, Va.
8.	Jackson River	18.6	Bridge on County Route 18 (South Carpenter Street) Parrish Court, Va.
9.	Jackson River	15.8	Bridge - Chesapeake and Ohio Railroad @ Mallow, Va.
10.	Jackson River	13.7	Bridge on I-64 (US Routes 60 & 220) east of Mallow, Va.
11.	Jackson River	11.9	Bridge on County Route 1101 1 mile west of low Moor Exit of I-64

Station No.	Basin	River Mile	Description
12.	Jackson River	5.4	Bridge on US Routes 60 & 220 @ west edge of Clifton Forge, Va.
13.	Jackson River	3.6	Clifton Forge, Va. municipal wastewater treatment plant outfall
14.	Jackson River	0.5	Bridge on County Route 727 south of Iron Gate. Va.
	James River	339.7	Confluence of Jackson River and Cowpasture River (not a sampling station)
15.	Cowpasture River	2.5	Bridge on County Route 633 near Iron Gate, Va. (USGS gage 0201600)
16.	James River	338.9	Bridge on US Route 220 @ Lick Run, Va. (USGS Gage 0201600)
17.	James River	335.9	Bridge on County Route 622 @ Glen Wilton, Va.
18.	Craig Creek	0.5	Bridge on County Route 615 @ Bessemer, Va.
19.	James River	301.2	Bridge on U.S. Route 11 @Buchanan, Va. (USGS Gage 02019500)

Section II

Station No.	Basin	River Mile	Description
20	James River	281.9	Bridge on County Route 759 near Natural Bridge Station, Va.
	James River	279.5	Confluence with Maury River (not a sampling point)
21	James River	274.2	Bridge on US Route 501 near Snowden, Va.
22	James River	271.5	Foot Bridge under Blue Ridge Parkway @ James River visitors' center (N.P.S.) near Major, Va.
23	James River	269.9	Owen-Illinois industrial waste-water treatment plant outfall @ Big Island, Va.
24	James River	269.8	1000 feet downstream from dam at Big Island, Va.
25	James River	269.0	Confluence with Reed Creek @ Big Island, Va.
26	James River	267.7	Confluence with Skimmer Creek, near Big Island, Va.
27	James River	266.4	100 feet upstream from dam @ Coleman Falls
28	James River	266.1	100 feet downstream from dam @ Coleman Falls, Va.
29	James River	264.2	Confluence with Pedlar Creek near Holcomb Rock, Va.
30	James River	263.2	At USGS Gage Station #02025500 @ Holcomb Rock, Va.

Group A

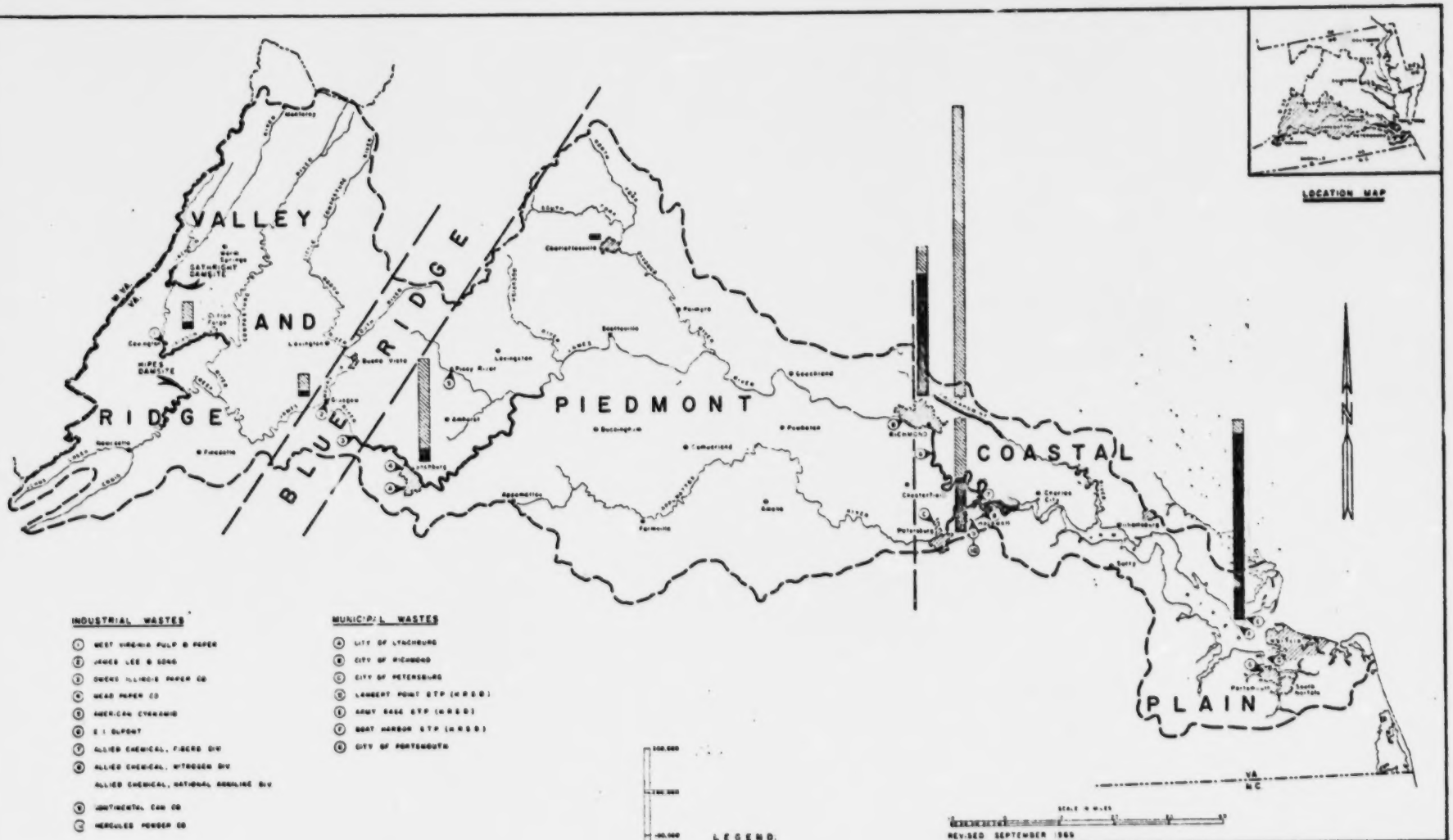
Station No.	Basin	River Mile	Description
30	James River	263.2	At USGS Gage Station #02025500 @ Holcomb Rock, Va.
31	James River	256.0	Reusens Dam near Reusens, Va.
32	James River	252.3	Off downstream end of Daniel Island, upstream from dam @ Lynchburg, Va.
33	James River	251.8	Glamorgan Pipe and Foundry Co. wastewater treatment plant outfall
34	James River	250.8	Lynchburg Foundry Co. wastewater treatment plant outfall
35	James River	250.3	The Mead Corp. wastewater treatment plant outfall
36	James River	249.8	Lynchburg, Va. wastewater treatment plant outfall

Group B

37	James River	245.8	Six Mile Railroad Bridge near Kelly Va.
38	James River	242.6	Nine Mile Railroad Bridge near Joshua Falls, Va.
39	James River	237.2	Confluence with Beck Creek @ Galt Mills, Va.

Group C

Station No.	Basin	River Mile	Description
40	James River	235.6	Confluence with Partridge Creek @ Stapleton, Va.
41	James River	227.9	Off Riverville, Va.
42	James River	222.9	Bridge on US Route 60 @ Bent Creek, Va. (USGS Gage #02026000)
43	James River	184.6	Bridge Va. State Highway 20 @ Scottsville, Va. (USGS Gage #02029000)
44	James River	152.4	Bridge Va. State Highway 45 @ Cartersville, Va. (USGS Gage #2035000)
45	James River	135.2	Upstream from Bridge US Route 522 @ Maidens, Va. (State Farm for woman)
46	James River	118.1	Upstream edge of Tuckahoe Island @ Goochland & Henrico County Line.
47	James River	111.7	Bridge Va. State Highway 147 near Richmond, Va. (USGS Gage #02037500)



JAMES RIVER BASIN
CHESAPEAKE BAY DRAINAGE AREA

JAMES RIVER BASIN
PRINCIPLE MUNICIPAL & INDUSTRIAL WASTE SOURCES
POPULATION EQUIVALENTS (P.E.) DISCHARGED AS OF 1967

U.S. ENVIRONMENTAL PROTECTION AGENCY
MIDDLE ATLANTIC REGION
REGION III PHILADELPHIA, PA.

FIGURE 5

Chapter IV

Analytical Data - Physical, Chemical and Bacterial

LA - Lab Accident

Data Sheet 1 of 9

1973 Date	Station No.	Flow	Temp	Field pH	Sp. Cond.	Field D.O.	Color	Trub.	Lab pH	Acdty	Alk	TOC	COD	BOD_5	BOD_{10}	BOD_{15}	BOD_{20}	SO_4	Cl^-
		cfs	°C	units	um/cm	mg/l	units	JTO	units	mg/l $CaCO_3$	←			mg/l					→
5/15	1	606	14	7.7	159	10.9	5	3.2	7.7	2.7	61	2.5	3.3	0.85	0.95	1.35	1.35	12	1.5
	2		15	7.7	140	10.4	5	2.6	7.7	2.8	51	2.2	3.2	0.85	0.90	1.30	1.40	13	1.6
	4	92	14	7.5	200	10.0	5	2.5	7.8	2.9	64	2.2	3.8	0.55	1.00	1.05	1.25	28	2.9
5/16	5		15	8.2	350	8.6	80	9.2	7.5	6.2	70	11	30	4.1	6.8	11.7	13.1	34	33
	6		15	7.2	370	7.9	80	8.7	7.3	5.6	62	12	31	3.75	6.15	8.95	9.45	50	36
	8		15	7.7	325	8.4	60	7.8	7.4	4.3	70	9.7	25	3.4	5.2	7.25	8.35	32	30
	9		15	8.2	310	8.2	60	6.7	7.6	4.2	68	7.8	20	2.4	3.6	5.4	6.2	30	25
	10		15	8.1	300	8.2	60	6.5	7.5	4.6	67	6.9	20	2.25	4.05	5.1	6.1	31	24
	11		18	7.8	280	7.0	50	6.7	7.5	4.4	69	7.2	18	2.0	3.35	4.4	5.3	30	23
5/17	12		15	8.0	310	9.6	60	6.2	7.6	3.4	67	8.3	21	2.1	3.35	4.9	5.45	32	31
	14		15	7.7	310	9.0	60	5.1	7.6	3.2	66	11	21	1.95	3.0	4.35	4.9	27	28
	15	430	14	8.0	110	10.0	5	2.1	7.65	2.4	56	1.8	4.2	0.55	0.60	0.95	1.3	9	1.5
	16	1570	13	7.9	260	10.1	45	6.2	7.5	4.0	60	6.3	15	4.55	7.35	9.95	10.55	19	20
	17		14	7.8	260	9.0	45	4.7	7.5	3.2	58	5.6	13	2.3	2.85	4.1	4.55	22	20
5/22	18		17	8.3	250	8.0	20	3.6	7.8	3.0	78	4.1	10	1.05	1.75	2.55	3.25	12	14
	19		18	8.5	250	9.1	10	4.5	7.9	1.6	83	4.3	10	1.95	3.7	4.4	4.7	12	10
	20		19	8.4	240	8.2	10	2.3	8.0	1.2	84	3	8	1.2	2.0	2.8	3.3	12	10
5/23	22		18	8.5	250	9.1	25	4.6	7.8	2.6	83	5.1	21	1.9	3.6	4.5	4.9	11	14
	23		18	8.5	255	9.2	15	3.4	7.9	3.6	84	4.2	11	0.95	1.75	2.4	2.35	10	10
	24		19	8.9	250	9.2	15	3.4	7.9	2.4	74	4.5	13	1.0	1.9	2.25	2.55	10	10
	25		19	8.9	250	7.5	20	3.4	7.9	5.6	95	5.7	14	2.75	3.9	4.65	4.95	12	10
5/24	26		19	8.7	240	9.4	60	6	7.7	4.8	87	9.1	24	4.85	7.55	8.75	9.25	8	9
	27		19	8.6	260	9.4	35	3.7	7.8	3.3	86	6.3	18	2.5	3.6	3.95	4.7	9	11
5/22	28		20	8.1	240	7.0	30	4.5	7.9	3.2	85	5.3	13	1.75	3.5	3.9	4.45	10	11
6/27	37		26	7.8	240	6.7	20	6.2	7.3	2.9	76	5.5	12					17	11
	38		26	8.1	235	7.5	20	6.9	7.5	2.1	74	5.1	10					15	11
	39		28	8.2	220	7.2	20	5.6	7.5	2.0	79	4.9	10					19	11
	40		28	8.4	235	6.5	20	5.8	7.5	2.0	74	4.7	10					18	13
	41		28	8.5	210	8.6	20	5.0	7.5	1.0	73	4.7	10					17	12
	42		27	8.4	250	9.2	20	2.7	7.7	1.6	70	3.8	10					14	12

LA - Lab Accident

1973 Date	Station No.	TKN	NO_2-N	NO_3-N	NH_3-N	Total P	Oroth P	Total Solids	Susp. Solid	Fe	Mn	Cu	Cr	Al	Zn	Ni	Ca	Mg	Hg
		←						mg/l										→	ug/l
5/15	1	.84	.002	.098	<.02	.020	.015	86	2.8	.45	<.05	<.01	<.05	15.5	<.02	.07	18	4.6	1.4
	2	<.04	.002	.078	.02	.037	.010	81	1.2	.12	<.05	<.01	<.05	.79	<.02	<.02	18	3.6	1.8
	4	<.04	.002	.088	.03	.042	<.01	117	0.4	.66	<.05	<.01	<.05	50	<.02	<.02	34	10	1.8
5/16	5	.72	.006	.030	.07	.113	<.01	222	LA	.70	.10	<.01	<.05	22	.05	<.02	26	5.9	0.8
	6	.50	.006	.149	.13	.080	.020	734	12.4	.79	.12	<.01	.05	29	.02	.03	28	6.7	1.0
	8	.84	.001	.079	.10	.070	<.01	201	12.8	.30	.08	<.01	.05	1.2	<.02	<.02	17	3.7	1.0
	9	.78	.011	.060	.10	.080	<.01	188	7.6	.21	.07	<.01	<.05	.43	<.02	.03	14	4.0	0.8
	10	.61	.014	.081	.08	.080	.015	183	6.8	<.05	<.05	<.01	<.05	.25	<.02	<.02	31	.62	1.0
	11	.08	.013	.067	.025	.120	.015	179	8.8	.25	.07	<.01	<.05	.56	.02	<.02	14	4.1	0.8
5/17	12	.33	.013	.067	.05	.070	.015	203	7.2	.30	.06	<.01	<.05	.81	.02	.02	18	4.2	1.0
	14	.22	.016	.094	.045	.080	.020	184	0.8	.41	<.05	<.01	<.05	.40	.03	.03	20	4.1	1.7
	15	.05	.001	.009	.045	.085	.028	58	1.2	.20	<.05	0.02	<.05	.43	.02	<.02	7.7	2.4	1.8
	16	1.13	.015	.065	<.02	.090	.010	157	10	.80	.11	0.01	<.05	32	.07	.02	14	8.2	2.5
	17	.89	.013	.077	<.02	.085	.015	149	5.6	.86	.14	0.01	<.05	59	.07	.03	15	12	2.0
5/22	18	<.04	.002	.008	<.02	.030	.013	210	26	.68	.26	<0.01	<.05	3.3	.03	.03	32	55	0.5
	19	.78	.003	.007	<.02	.046	<.01	230	26	.71	.10	0.02	<.05	18	.04	<.02	39	20	1.2
	20	.95	.002	<.007	<.02	.030	<.01	205	20	.84	.10	0.01	<.05	34	.05	<.02	48	22	0.6
5/23	22	1.12	.002	.008	.09	.025	<.01	198	22	.21	<.05	<.01	<.05	1.4	<.02	<.02	26	14	0.45
	23	.89	.002	.008	<.02	.030	<.01	190	22	.19	<.05	<.01	<.05	.40	.05	<.02	25	11	0.3
	24	<.04	.002	.008	<.02	.046	<.01	201	20	.23	.06	<.01	<.05	3.1	.03	<.02	26	17	0.5
	25	1.12	.003	.032	<.02	.042	<.01	202	21	.72	.10	<.01	<.05	14.7	.04	<.02	38	18	1.0
5/24	26	<.04	.002	<.007	<.02	.056	<.01	210	25	.28	<.05	<.01	<.05	3.75	<.02	<.02	20	6.9	0.3
	27	<.04	.002	<.007	<.02	.037	<.01	185	27	.30	<.05	<.01	<.05	4.40	<.02	<.02	27	6.5	0.5
5/22	28	.73	.002	.093	<.025	.025	<.01	188	30	.71	.09	<.01	<.05	19	.04	<.02	40.	18	0.4
6/27	37	.55	.017	.333	<.01	.107	.016	166	8.8	.52	.04	<.01	<.05		<.02	<.02	9.7	5.2	
	38	.44	.014	.136	<.01	.075	.028	145	5.2	1.1	.26	<.01	<.05		.06	<.02	16.4	26	
	39	.35	.015	.205	<.01	.093	.038	167	7.6	.54	.04	<.01	<.05		.06	<.02	9.4	4.9	
	40	.45	.018	.262	<.01	.078	.030	167	6.8	.80	.16	.02	<.05		.03	<.02	12.2	18	
	41	.24	.013	.157	<.01	.043	.026	168	6.4	1.12	.27	.03	<.05		.03	<.02	16.6	30	
	42	.64	.008	.342	<.01	.086	.012	160	5.2	.76	.12	.035	<.05		.06	<.02	13.7	12	

Data Sheet 3 of 9

1973 Date	Station No.	Ca&Mg Hardness mg/l-CaCo	Total Coliform ←No./100 ml	Fecal Coliform	Fecal Coliform →
5/15	1	65	120	< 100	<100
	2	59	180	< 100	<100
	4	125	140	< 100	80
5/16	5	89	TNTC	TNTC	450
	6	98	TNTC	TNTC	540
	8	57	TNTC	TNTC	1580
	9	51	TNTC	TNTC	300
	10	3.3	TNTC	TNTC	680
	11	52	TNTC	TNTC	360
5/17	12	61	9000	5000	200
	14	66	8600	3000	530
	15	29	400	200	630
	16	68	2800	2100	930
	17	87	4500	1100	300
5/22	18	303	1700	<100	1520
	19	178	2400	200	265
	20	213	700	<100	135
5/23	22	119	1300	200	33
	23	106	3700	<100	365
	24	135	3700	<100	200
	25	170	4100	<100	930
5/24	26	77	4200	<100	200
	27	93	5000	<100	265
5/22	28	174	1600	<100	66
6/27	37	46			
	38	149			
	39	44			
	40	103			
	41	167			
	42	82			

Date: 12/17/73 EPA, Region III, Technical Support Laboratory Data Sheet 4 of 9 James River Survey

Station No.	Date Sampled	Lab PH	Acdty	Alk	Color	Turb.	TOC	COD	Total Solids	Susp. Solids	Dis. Solids	Cl^-	$SO_4^=$	NO_2-N	NO_3-N	NH_3-N	TKN	Org-N	Total P	Ortho P
		units	$CaCO_3$ mg/l		units	FTU	mg/l													
1	9/18/73	7.9	1.5	94	0	.9	2.7	4.6	152	20	153	1.7	33	.007	<.01	<.01	<.05	<.05	.073	.04
2		8.0	2.2	90	0	.75	2.5	3.4	147	4.0	149	3.0	28	.005	<.01	.01	<.05	<.05	.05	.045
3 *		7.3	25	219	900	6.9	132	386	2197	114	1678	665	387		.040	1.5	1.62	.12	.415	.055
3		7.3	24	226	1000	5.6	136	405	1792	100	1888	558	303		.055	2.65	2.64	.01	.383	.073
5		7.5	8.9	140	300	7.8	61	119	724	13	660	240	100	.030	.034	.81	.86	.05	.208	.063
8		7.5	7.4	121	150	7.0	28	69	584	12	504	118	93	.056	.043	1.0	.98	<.05	.105	.053
10		7.6	9.3	104	200	5.5	17	53	586	10	520	122	101	.370	.250	.63	.65	.02	.053	.05
14		7.7	4.8	99	100	2.3	11	27	521	7.5	394	62	84	.056	.548	.05	<.05	<.05	.25	.092
15		7.7	2.0	72	5	.72	1.5	2.7	93	3.2	87	1.9	5.8	.003	<.01	<.01	<.05	<.05	.33	.178
18		7.6	2.3	73	5	1.4	1.0	3.2	87	3.2	85	1.7	5.4	.003	<.01	<.01	<.05	<.05	.165	.01
19		7.8	2.5	108	80	26	7.9	19	326	12	304	45	5.4	.068	.632	.05	<.05	<.05	.08	.042
1	9/20/73	8.0	6.5	98	0	2.7	0.5	4.5	188	5.4	156	1.1	33	.029	<.01	.035	.07	.035	.083	.015
2		7.9	2.4	95	0	1.0	0.2	5.8	148	3.6	93	2.2	31	.005	<.01	.04	<.05	<.05	.083	.02
3 *		7.3	35	201	900	7.0	138	498	2292	132	2128	708	460		.070	3.02	3.54	.52	.576	.07
3		7.2	37	214	1000	6.3	159	665	2353	154	2088	667	405		.045	3.5	3.56	.06	.482	.105
5		7.5	12	136	300	9.2	43	129	884	22	733	158	136	.030	.017	.89	.86	<.05	.045	.045
8		7.7	10	116	150	8.3	29	90	649	15	606	150	144	.040	.304	1.55	1.67	.02	.225	.075
10		7.7	25	115	200	5.7	20	55	454	56	419	162	456	.370	.680	.57	.57	<.05	.14	.135
14		7.8	3.8	113	100	5.5	23	48	514	8	487	100	98	.075	.806	.10	.15	.05	.205	.11
15		7.9	2.0	76	5	1.8	2.8	5.6	104	7	88	.8	5.8	.004	<.01	<.01	<.05	<.05	1.115	.04
18		7.7	2.8	76	5	1.2	2.2	3.2	98	1.6	92	1.4	5.8	.001	<.01	<.01	<.05	<.05	.045	.04
19		8.0	2.7	110	75	2.2	15	27	279	14.5	246	38	5.4	.022	.644	.01	<.05	<.05	.10	.085
20	10/16/73	8.0	1.0	99	25	5.8	3.4	11	234	5.2	230	26	35	.015	.200	<.01	.05	<.05	.04	.025
21		8.0	1.0	102	25	8.5	3.4	11	240	10.8	236	24	35	.018	.217	<.01	.07	<.05	.10	.037
23 *		7.8	24	650	1500	410	241	1123	1626	504	1075	28	23		1.27	.52	1.7	.18	.38	.015
23		7.9	11	373	1000	320	106	643	1121	400	725	28	23		.345	.27	1.05	.78	.30	.015
25		7.7	4.3	118	80	11	18	103	259	16.4	253	19	36	.044	.056	.02	.20	.08	.12	.015
26		7.8	3.1	102	25	6.8	6.9	21	229	7.2	234	22	33	.031	.183	<.01	.08	<.05	.12	.025
27		7.8	2.9	103	50	6.9	5.7	20	223	6.4	224	21	30	.026	.174	<.01	.06	<.05	.10	.023
30		7.7	3.9	121	40	7.3	5.1	18	221	9.6	213	21	28	.020	.150	<.01	<.05	<.05	.09	.018
32		7.7	2.9	91	30	6.5	4.1	14	177	9.2	172	13	20	.018	.172	<.01	.07	<.05	.12	.023
37		7.6	2.9	97	25	10	5.7	20	171	10.4	168	13	21	.055	.179	.105	.18	.075	.23	.11
20	10/18/73	7.8	3.0	104	35	5	5.6	16	260	6.2	258	32	50	.020	.265	<.01	.07	<.05	.05	.023
21		8.0	1.0	105	30	5	2.4	10	213	7.2	208	21	32	.020	.180	<.01	.07	<.05	.07	.028
23 *		7.9	23	702	1500	500	287	1340	1864	640	1085	24	11		.720	.43	.72	.29	.82	.03

Samples for color were filtered thru fiber filter
*24 hr. composite samples

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Station No.	Date Sampled	Tan. Lig.	Chloro a	Chlord b	Chloro c	Corr. Chl.a	Fe	Cr	Mn	Zn	Cu	Ni	Ca	Mg	Hg	Hard-ness	Field Temp	Field Cond.	BOD_2	BOD_5
		mgl	ugl				mgl								ugl Ag	CaCo$_3$	°C	µ/cm^3	mg	
1	9/18	.17	.50	-	1.34	.35	.11	<.01	.015	.005	<.005	<.005	35	6.2	1.01	26	19.5	<50	.55	1.0
2		.20	.96	.41	-	.94	.058	<.01	.01	<.005	<.005	<.005	33	5.9	1.01	24	20	260	.75	.95
3		53	x	x	x	x	1.05	.025	2.65	.175	.0275	<.005	125	7.2	1.16	342			22	38
3		55	x	x	x	x	.84	.02	2.65	.125	.015	<.005	109	7.1	1.31	301	37	2500	19	x
5		14	5.62	9.88	26.61	10.19	.445	.01	.875	.03	.005	<.005	64	6.8	.72	188	27	1000	3.4	7.5
8		8.9	2.05	4.45	17.58	5.91	.423	.01	.605	.03	<.005	<.005	54	6.1	.87	160	23	750	2.9	6.6
10		6.5	x	x	x	x	.418	.01	.620	.02	<.005	<.005	55	6.0	1.6	162	25	710	4.3	6.6
14		2.7	1.72	3.19	2.83	3.51	.285	<.01	.31	.015	<.005	<.005	41	5.8	1.16	126	24.5	670	1.05	2.6
15		.19	.14	.87	2.76	11.82	.14	<.01	.02	<.005	<.005	<.005	26	3.2	1.01	78	23	190	.55	1.35
18		.23	.21	-	-	.70	.108	<.01	.065	<.005	<.005	<.005	22	4.4	.87	73	22.5	180	.60	0.7
19		1.8	.38	.13	.51	.001	.335	<.01	.10	.01	<.005	<.005	38	7.6	1.6	126	23	450	.85	1.5
1	9/20	.15	1.42	.80	1.48	2.59	.108	<.01	.015	.005	<.005	<.005	37	6.5	.58	119	16.5	280	.50	.90
2		.11	1.11	.83	2.56	1.39	.063	<.01	.01	<.005	<.005	<.005	37	6.8	1.16	120	17	260	.60	.90
3		54	x	x	x	x	1.34	.014	2.75	.145	.02	<.005	126	8.0	1.89	348			14	30
3		63	x	x	x	x	1.4	.025	3.15	.165	.0275	<.005	131	8.1	1.6	360	36	2800	15	39
5		11	9.17	15.21	53.87	25.24	.485	<.01	.875	.05	<.005	<.005	101	7.6	.72	383	25	1100	3.7	8.3
8		9.7	.78	2.17	11.58	-	.48	<.01	.795	.045	<.005	<.005	85	6.4	1.01	238	21	570	2.7	6.3
10		6.2	4.61	5.05	15.67	7.34	.525	<.01	.575	.045	<.005	<.005	75	6.3	1.45	213	22	950	2.3	4
14		4.7	5.99	5.28	18.11	8.8	.455	<.01	.45	.025	<.005	<.005	81	6.2	1.16	228	20	800	1.6	3.2
15		.16	.73	.65	1.94	1.09	.135	<.01	.32	.02	<.005	<.005	26	3.1	1.6	78	19	195	.70	1.0
18		.13	2.03	.43	.90	2.56	.113	<.01	.035	.03	<.005	<.005	23	4.4	1.01	76	17	195	.45	1.05
19		.94	2.31	1.03	2.48	3.57	.44	<.01	.10	.025	<.005	<.005	42	7.7	1.16	136	19.5	470	1.1	1.4
20	10/16	.75	4.40	1.48	5.18	5.56	.295	<.01	.025	.02	<.005	<.005	45	6.9	1.45	141	17	400	.20	.75
21		.71	4.06	.91	3.64	5.56	.435	<.01	.03	.01	<.005	<.005	46	7.4	1.6	145	18	400	.30	.55
23		103	x	x	x	x	4.48	.09	1.21	.075	.048	.048	52	7.7	3.2	162	26	810	17	40
23		94	x	x	x	x	3.35	.16	.77	.065	.039	.068	48	8.1	3.49	153	19.5	380	15	36
25		6.3	13.91	15.7	69.43	23.77	.34	<.01	.075	.005	<.005	<.005	43	7.4	3.05	138	19	340	5.7	9.7
26		2	6.26	5.08	15.38	9.8	.345	<.01	.045	<.005	<.005	<.005	42	7.1	2.76	134	18.5	345	2.0	2.8
27		1.8	6.28	4.31	15.91	9.24	.355	<.01	.045	.005	<.005	<.005	42	7.2	2.62	135	19	340	1.0	1.8
30		1.0	4.52	3.31	11.42	6.29	.465	<.01	.055	<.005	<.005	<.005	40	6.9	1.6	128	19	340	.85	1.35
32		1.3	6.01	1.78	6.70	8.69	.34	<.01	.04	<.005	<.005	<.005	36	6.2	1.45	115	19	290	.50	.95
37		1.3	6.60	3.20	11.02	9.27	.68	<.01	.065	.03	<.005	<.005	41	5.4	4.07	100	18	320	2.6	4.2
20	10/18	1.0	3.94	1.09	4.02	5.33	.295	<.01	.035	.005	<.005	<.005	46	7.2	1.01	144	12.5	450	.25	.6
21		.58	3.96	.95	1.37	4.84	.245	<.01	.03	.01	<.005	<.005	44	7.7	1.16	142	14.5	380	.25	.7
23		192	x	x	x	x	5.25	.07	1.44	.09	.076	.053	61	9.4	3.34	191			39	76

x Parameter not run
- Not detected

Date: 12/17/73 EPA, Region III, Technical Support Laboratory Data Sheet 6 of 9

Station No.	Date Sampled	BOD_6	BOD_{10}	BOD_{11}	BOD_{16}	BOD_{18}	BOD_{20}	BOD_{28}	BOD_{29}	BOD_{40}	BOD_{4}	Total Col /100ml	Fecal Col /100ml	Fecal Strep /100ml	Field PH units	Field D.O. mgl	Flow cfs
		←		mgl							→						
1	9/18		1.0			1.6		1.7		1.8		4400	40	270	7.9	8.6	
2			.95			1.85		2.05		2.15		2200	10	130	7.9	8.6	
3			81			109		184		197		x	x	x	x	x	
3			51			83		125		141		x	x	x	6.7	0	
5			14			22		32		39		11000	4000	870	7.1	1.7	
8			14			23		35		38		10000	1500	530	7.3	2.8	
10			15			20		23		28		1900	100	330	6.6	4.0	
14			4.4			6.3		7.5		15		2600	100	270	6.2	7.5	
15			.85			1.6		2.1		2.05		600	100	30	6.7	9.0	
18			.90			1.4		1.95		1.9		7000	100	130	6.4	8.8	
19			2.1			3.2		4.2		4.5		68000	900	870	7.3	7.6	
1	9/20			.80	.80			1.5		1.7		13000	100	240	7.3	8.6	
2				.90	.95			1.5		1.8		6000	500	130	8.2	8.5	
3				66	80			122		179		x	x	x	x	x	
3				77	90			131		190		4000	100	30	7.0	0	
5				17	25			35		39		31000	3000	180	7.1	1.7	
8				15	22			30		33		51000	3400	210	7.3	3.6	
10				11	14			18		18		x	x	x	7.2	4.4	
14				6.2	8.1			11		13		x	x	x	7.2	7.4	
15				1.15	1.2			2.0		2.15		x	x	x	7.4	9.1	
18				.95	1.05			1.75		1.8		x	x	x	7.2	9.1	
19				1.7	2.0			2.7		3.4		x	x	x	7.8	8.4	
20	10/16		1.55				1.85	2.25		2.95		12000	100	160	8.1	7.9	
21			.90				1.6	2.6		3.05		17000	100	90	8.0	8.5	
23			78				134	178		213		x	x	x	x	x	
23			66				126	154		177		43000	TNTC	330	7.3	2.4	
25			15				24	36		37		x	x	x	7.2	x	
26			3.0				6.6	8.0		8.0		x	x	x	7.6	8.2	
27			2.0				5.2	6.4		6.5		x	x	x	7.4	7.9	
30			1.85				3.25	4.1		4.7		14000	200	100	7.8	7.2	1460
32			1.35				2.45	3.05		3.65		2500	100	190	7.7	6.6	
37			5.4				9.8	11		11.7		87000	3600	400	7.5	4.5	
20	10/18			1.0			2.0	2.4		2.8		14000	100	110	7.0	8.7	
21				1.3			1.9	2.1		2.5		14000	500	120	7.8	9.9	
23				158			229	281		328		x	x	x	x	x	

x Parameter not run

Date: 12/17/73 EPA, Region III, Technical Support Laboratory Data Sheet 7 of 9 James River Survey

Station No.	Date Sampled	Lab PH	Acdty	Alk	Color	Turb	TOC	COD	Total Solids	Susp. Solids	Dis. Solids	Cl^-	$SO_4^=$	NO_2-N	NO_3-N	NH_3-N	TKN	Org-N	Total P	Ortho P
		Units	A_3CaCo_3 mgl		units	JTO	←				mgl									→
23	10/18/73	7.9	12.6	432	1000	360	53	996	1221	440	620	27	7.4		.520	.38	1.04	.66	.48	.04
25		7.8	2.4	114	60	9.5	13	49	236	14.8	198	18	24	.024	.176	.01	.07	.06	.08	.05
26		8.1	1.0	105	50	7	6.2	22	233	6.4	193	20	30	.023	.167	<.01	.06	<.05	.12	.047
27		7.8	3.0	107	50	7.6	8.3	25	236	7.6	208	22	33	.022	.218	<.01	<.05	<.05	.10	.038
30		7.7	4.8	101	50	8	9.3	36	240	12	208	22	37	.025	.235	<.01	<.05	<.05	.12	.03
32		7.9	1.4	97	40	7.4	5.6	17	229	7.6	151	16	25	.034	.251	.01	<.05	<.05	.08	.03
37		7.6	4.8	94	30	8.6	9.1	24	217	7.2	158	15	25	.075	.225	.23	.27	.04	.34	.118
42	10/23/73	7.9	2.5	94	25	6	7.2	15	189	4	172	19	23	.031	.219	<.01	<.05	<.05	.13	.118
43		7.8	2.5	76	18	4	4.4	10	153	3.6	127	13	19	.012	.018	<.01	<.05	<.05	.03	.03
44		7.7	2.5	60	10	10	3.3	7.9	135	17.6	92	8	12	.009	.041	<.01	<.05	<.05	.07	.018
45		7.7	2.0	61	10	6.5	3.0	9.4	138	7.6	86	9.3	12	.010	<.01	<.01	<.05	<.05	.17	.156
46		7.8	3.0	59	7	4.5	2.1	7.4	106	4	104	8	11	.012	.213	<.01	<.05	<.05	.05	.015
47		7.7	2.5	59	5	3.5	3.6	9.3	113	5.2	106	7.4	11	.011	.050	<.01	<.05	<.05	.03	.02
42	10/25/73	7.7	3.5	93	45	10	11	14	179	4.4	183	19.5	27	.022	.399	<.01	<.05	<.05	.09	.03
43		7.8	1.5	64	15	4.7	5.3	13	148	3.2	142	16	22	.009	<.01	<.01	<.05	<.05	.04	<.01
44		8.1	1.0	78	7	7.2	3.2	9	118	3.6	121	13	17	.010	.045	<.01	<.05	<.05	.06	.012
45		7.8	2.0	58	5	5.5	15	12.7	104	3.2	106	9.4	14	.009	.061	<.01	<.05	<.05	.09	.015
46		7.7	2.0	60	7	5.5	3.4	7.6	109	3.2	108	8.7	12	.008	.012	<.01	<.05	<.05	.03	<.01
47		7.8	2.0	57	10	2.5	2.8	6.7	97	.8	100	8.9	13	.008	<.01	<.01	<.05	<.05	.04	<.01

Samples for color were filtered thru fiber filter

Date:12/17/73 EPA, Region III, Technical Support Laboratory Data Sheet 8 of 9

Station No.	Date Sampled	Tan. Liq. mgl	Chloro a ug/l	Chloro b ug/l	Chloro c ug/l	Corr Chl a ug/l	Fe mgl	Cr mgl	Mn mgl	Zn mgl	Cu mgl	Ni mgl	Ca mgl	Mg mgl	Hg ug/l	Hard-ness $mg/l\ CaCO_3$	Field Temp °C	Field Cond. $\mu mho/cm^3$	BOD_2 mgl	BOD_5 mgl
23	10/18	115	x	x	x	x	4.55	.11	.96	.10	.07	.085	55	8.9	3.34	174	22.5	825	23	61
25		3.4	8.25	8.56	30.7	13.3	.35	<.01	.055	.005	<.005	<.005	43	7.5	2.91	138	15.5	340	2.6	4.6
26		1.7	6.53	5.10	18.5	11.96	.305	<.01	.05	.005	<.005	<.005	42	7.1	2.91	134	15.5	340	1.3	2.3
27		2	7.41	5.77	17.63	15.99	.33	<.01	.05	<.005	<.005	<.005	43	7.4	2.18	138	15	380	1.0	2.4
30		1.7	5.57	3.30	10.74	9.7	.44	<.01	.055	.005	<.005	<.005	42	7.4	2.03	135	15	400	.60	1.5
32		1.3	5.86	2.03	7.84	7.78	.43	<.01	.045	<.005	<.005	<.005	32	7.2	1.45	110	17	340	.30	1.05
37		1.2	6.56	4.36	16.73	-	.44	<.01	.065	.03	<.005	<.005	32	7.5	2.76	111	14.5	340	1.6	4.6
42	10/23	1.0	8.41	1.36	3.91	11.04	.338	<.01	.07	.015	<.005	<.005	25	5.9	3.34	87	14	340	.6	
43	"	.64	4.35	.97	3.35	6.26	.285	<.01	.04	<.005	<.005	<.005	22	4.9	1.89	75	14.5	260	.55	
44		.44	3.56	.63	3.3	4.57	.445	<.01	.06	<.005	<.005	<.005	16	3.5	3.34	54	14.5	170	.25	
45		.41	11.49	.05	4.11	16.37	.488	<.01	.075	.01	<.005	<.005	17	3.5	2.62	57	15.5	200	.30	
46		.35	2.97	.08	1.54	4.08	.36	<.01	.055	<.005	<.005	<.005	15	3.4	3.2	51	15	190	.40	
47		.40	.91	.88	3.15	.94	.398	<.01	.04	.02	<.005	<.005	16	3.6	3.05	55	17	190	.10	
42	10/25	1.03	9.68	1.25	7.27	12.87	.293	<.01	.06	.015	<.005	<.005	25	6.1	3.78	88	15	340	.55	1.0
43		.61	5.75	.60	3.15	7.57	.33	<.01	.045	.03	<.005	<.005	22	5.3	1.89	77	15	260	.55	1.0
44		.50	4.48	.71	1.64	6.27	.463	<.01	.04	.01	<.005	<.005	17	3.9	3.34	59	15	200	.45	.90
45		.49	x	x	x	x	.36	<.01	.055	.01	<.005	<.005	15	3.5	3.78	52	15	190	.65	1.1
46		.40	2.85	.73	1.44	4.31	.338	<.01	.05	.01	<.005	<.005	16	3.4	3.05	54	16	200	.35	.75
47		.35	.73	.70	2.06	0	.208	<.01	.055	<.005	<.005	<.005	15	3.7	3.2	53	18.5	180	.48	.90

x Parameter not run
- Not detected

Date: 12/17/73 EPA, Region III, Technical Support Laboratory Data Sheet 9 of 9

Station No.	Date Sampled	BOD_6	BOD_{10}	BOD_{11}	BOD_{16}	BOD_{18}	BOD_{20}	BOD_{28}	BOD_{29}	BOD_{40}	BOD_{41}	Total Col	Fecal Col	Fecal Strep	Field PH	Field D.O.	Flow
		mgl										/100ml	/100ml	/100ml	units	mgl	cfs
23	10/18			123			179	212		237		34000	24000	400	7.6	3.0	
25				7.4			13	14.5		16		x	x	x	7.9	8.5	
26				3.3			5.6	6.5		7.4		x	x	x	8.2	8.8	
27				3.8			5.7	6.6		8.4		x	x	x	7.7	8.1	
30				2.4			3.4	3.9		4.8		2800	8000	80	6.9	7.6	914
32				1.95			2.7	3.1		3.5		3500	300	230	6.9	6.7	
37				7.1			10.3	11.7		12.7		37000	8000	470	7.3	5.0	
42	10/23	1.35	2.15				3.05	3.6			4.5	x	x	x	7.1	9.2	1546
43	"	1.35	1.85				2.55	3.15			4.25	x	x	x	8.2	9.9	1280
44		.80	1.0				1.75	2.0			2.45	x	x	x	8.0	9.6	1930
45		1.3	1.85				2.3	3.0			3.5	x	x	x	8.0	10.2	
46		.90	1.25				1.55	2.15			2.6	x	x	x	7.8	9.8	
47		.50	.95				1.05	1.45			1.95	x	x	x	7.5	10.6	1460
42	10/25		1.8				2.45		3.2		3.4	x	x	x	7.5	9.4	7094
43			2.1				2.35		2.8		2.75	x	x	x	7.8	10.2	1550
44			1.25				2.0		2.65		2.55	x	x	x	7.1	9.7	1640
45			1.7				2.5		3.0		2.95	x	x	x	7.6	9.6	
46			1.15				1.95		2.1		2.15	x	x	x	7.5	9.6	
47			1.4				1.95		2.25		2.3	x	x	x	7.8	10.1	

x Parameter not run

Chapter V - Biological Data

NARRATIVE

During October and November of 1972 an attempt was made to monitor the Jackson-James Rivers between Covington and Lynchburg, Virginia. Due to limited personnel and time, the program was terminated after one sampling period. We had decided to use the benthic population as the biological parameter to measure water quality. Hester-Dendy artificial substrates were set in place for a six-week exposure period to allow the benthic population to build up.

Bottom organisms have been placed in three general categories according to the severity of decomposable organic wastes which they may tolerate.

Intolerant (pollution sensitive) organisms are those organisms that have not been found associated with even moderate levels of organic contaminants and are generally intolerant of even moderate reductions in dissolved oxygen.

Facultative (intermdediate) organisms are those organisms having a wide range of tolerance and frequently associated with moderate levels of organic contamination.

Tolerant organisms are those organisms frequently associated with gross organic contamination and generally capable of thriving under anaerobic conditions.

In unpolluted streams a wide variety of intolerant clean water associated bottom organisms are normally found. Typical groups are stoneflies, mayflies, caddisflies, and riffle beetles. These sensitive organisms ususally are not individually abundant because of natural predation and competition for food and space; however, the total count or number of organisms at a given station may be high because of the different varieties present. Sensitive genera (kinds) tend to be eliminated by adverse environmental conditions (e.g., chemical and/or physical) resulting from wastes discharging into the stream.

In waters enriched by organic wastes comparatively fewer kinds of animals are found, though great numbers of certain genera may be present. Organic pollution tolerant forms such as sludgeworms, rattailed maggots, certain species of bloodworms (red midges), certain leeches, and some species of air-breathing snails may multiply and become abundant because of a favorable habitat and food supply. These organic pollution-tolerant bottom organisms may also exist in the natural environment, but are generally found in small numbers. The abundance of these forms in streams heavily polluted with organics is due to their physiological and morphological abilities to survive environmental conditions more adverse than conditions tolerated by other organisms. Under conditions where inert silts or

organic sludges blanket the stream bottom, the natural home of bottom organisms is destroyed which also causes a reduction in the number of kinds of organisms present.

Streams grossly polluted with toxic wastes such as mine drainage, etc., will support little, if any, aquatic life and will reduce the population of both sensitive and pollution-tolerance organisms.

In addition to intolerant (sensitive) and pollution-tolerant forms, some bottom organisms are termed facultative (intermediate) in that they are capable of living in moderately polluted areas as well as in limited numbers and, therefore, cannot serve as effective indicators of water quality.

For purposes of this report, the community of bottom macroinvertebrates was selected as the main indicator of the biological conditions in the stream since they serve as the preferred food source for higher aquatic forms and exhibit similar reactions to adverse stream conditions. Macrobottom organisms are animals that live in direct association with the stream bottom and are visible with the unaided eye. They are further distinguished from microorganisms by the fact they are retained in a 30 mesh sieve (approx. 0.5 mm aperture). The combination of limited locomotion and life cycles of one year or more for most benthic species provide a long-term indicator of stream water quality.

The diversity index $\bar{d}$ and equitability "e" which are additional diagnostic tools for measuring water quality and the effect of induced stress on the structure of the macroinvertebrate community were not used because the samples contained less than 100 specimens in the quantitative sample. Under 100 it is recommended that the samples should be evaluated with caution, if at all.

Station #1,which also served as a control, was located at the Virginia Route 687 Bridge across the Jackson River at Clearwater Park upstream from Covington, Virginia. High quality water was indicated by the 17 kinds (genera) of bottom organisms and the fact that 62% of the square foot sample consisted of clean water associated forms. Facultative (intermediate) organisms made up 35% of the quantitative sample and only 3% were forms tolerant of decomposable organic wastes. Clean water associated mayflies and caddisflies were the dominant bottom organisms sampled. Only 37 bottom organisms were collected in the square foot sample but this can be attributed to the high flow conditions which prevailed during the exposure period.

In the summer of 1966 the author sampled 48 different kinds (genera) of organisms and 288 bottom organisms in the square foot sample. Clean water forms made up 78% of the quantitative sample at that time. The difference in productivity and the high diversity of bottom organisms can be attributed to the sampling at low-flow

Conditions in 1966 and the different technique in sampling. In 1966 we made a transect across the Jackson River and sampled all the various micro-habitats qualitatively and this accounted for the large number of genera (kinds) found. The quantitative sample was taken using the Surber Square Foot Sampler while in 1972 the quantitative sample was taken using two Hester-Dendy Artificial Substrate Samplers (2 sq. ft.).

Station #2 was located on the Jackson River approximately 100 feet downstream from the U. S. 60 West Bridge in Covington, Virginia. This station was also sampled by using two Hester-Dendy artificial substrates (2sq. feet). The water at this location was a tea color from the Westvaco Corporation's pulp and paper operation located a short distance upstream from the bridge. The right bank is considerably clearer due to Dunlap Creek which enters from the right bank immediately upstream from the U. S. Route 60 West Bridge.

Poor water quality is suggested by the drop in number of genera to 11 versus 17 at the upstream station and the fact that the forms tolerant of decomposable organic wastes made up 82% of the square foot sample. Facultative forms made up 15% and clean water associated forms only 3%. These clean water forms were primarily sampled off the right bank and are undoubtedly drift organisms from Dunlap Creek. It is doubtful they would be found once the water has thoroughly mixed downstream.

Station #3 was located at the bridge on the Jackson River at Virginia County Route 18 (South Carpenter Street), Parrish Court, Virginia.

Both Hester-Dendy artificial substrates were washed away at high flows. Due to continuing high flows at the time the station was revisited, only a qualitative sample was taken. Only a few tolerant bristleworms and Physa sp. snails, plus a few facultative Gyraulus sp. snails, were found.

This station was located only 0.5 mile downstream from the Covington Municipal Sewage Treatment Plant and this could be largely responsible for the poor benthic population either through low dissolved oxygen or chlorination of the final effluent or both.

Station #4 was located at the Interstate 64 Bridge on the Jackson River east of Mallow, Virginia.

Both Hester-Dendy artificial substrates were washed out at high flows. Due to continuing high flows at the time the station was revisited, only a qualitative sample was taken. Only a few clean water caddisflies (2 genera) and a few tolerant Physa snails and bristleworms were collected. Based on this limited sampling, it is rather difficult to make concrete statements as to the water quality, but it is rather doubtful that conditions have changed much since 1966. In 1966 this location was sampled at low-flow conditions and the only

bottom organisms collected were organic pollution tolerant sludgeworms and Physa snails plus an intermediate midge larva. Heavy biological degradation was indicated at that time.

Station #5 was located on the James River at the Blue Ridge Parkway Bridge.

Fish were readily observed at this station and the water appeared much clearer than the upstream stations on the Jackson River downstream from the Westvaco Corporation.

Ten different genera of bottom organisms were found at this station, though only 20 organisms were collected in the square foot sample. Clean water assciated forms made up 55% of the quantitative sample. Facultative made up 30% and pollution tolerant forms 15%. Clean water associated caddisflies and mayflies dominated the square foot sample.

This station showed remarkable improvement over the upstream station where only four (4) genera of bottom organisms were found versus ten (10) at this station. A great deal of this improved water quality can be attributed to the Cowpasture River which joins the Jackson River downstream from Iron Gate, Virginia, to form the James River.

Station #6 was located on the James River at the upstream edge of Treasure Island at Lynchburg, Virginia.

Two (2) artificial substrates were put out at this station and both were recovered. Only nine (9) genera (kinds) of bottom organisms were found at this station versus ten (10) upstream. Degraded water quality can be noted in the composition change from the upstream station.

Though only 32 organisms were collected in the square foot sample, 84% of them were tolerant of decomposable organic wastes. Facultative organisms made up 13% and intolerant forms only 3%.

During this survey we also put out artificial substrates approximately 200 yards upstream from Pedlar Creek, but these were washed away during high flows.

This station was located downstream from Big Island, Virginia, and upstream from the Holcomb Rock Dam.

During 1973 the author of this report sampled by boat in the Big Island Pool downstream from the Owens-Illinois Plant at Big Island, Virginia. Sludge deposits were found in the lower half of the pool which were devoid of benthic organisms. Since this particular survey was for water chemistry samples, it is possible that some benthics may be found but it is believed they will be sparse and forms tolerant of decomposable organic wastes. It would appear that the poor water quality upstream from Treasure Island can be attributed to the situation at Big Island, Virginia.

The artificial substrates which were put out at Galts Mill downstream from Lynchburg, Virginia were washed out at high flows so it is impossible to comment on them. However, in 1966 when this station was sampled it supported 15 genera (kinds) of bottom organisms and the river appeared to be recovering from the Lynchburg discharges though mild pollution was still indicated.

TABLE I - Legal Descriptions of Biological Stations, Jackson-James River Survey, October - November 1972

Station #1 - Jackson River approximately 100 yards downstream from the Virginia County Route 687 Bridge upstream from Covington, Virginia.

Station #2 - Jackson River downstream from the U. S. Route 60 West Bridge in Covington, Virginia.

Station #3 - Jackson River at the Virginia Route 18 Bridge downstream from Covington, Virginia.

Station #4 - Jackson River at the U. S. Interstate 64 Bridge east of Covington, Virginia, and upstream from Clifton Forge, Virginia.

Station #5 - James River at the Blue Ridge Parkway Bridge.

Station #6 - James River at the upstream edge of Treasure Island in Lynchburg, Virginia.

TABLE II - Breakdown of Benthic Organisms by percentage into Tolerant, Facultative (Intermediate) and Intolerant (Sensitive) categories based on the tolerance of various macro-invertebrate taxa to decomposable organic wastes.

Station	Intolerant	Facultative	Tolerant
#1	62%	35%	3%
#2	3%	15%	82%
#3	-	33%	67%
#4	50%	-	50%
#5	55%	30%	15%
#6	3%	13%	84%

TABLE III - RESULTS OF BENTHIC ORGANISMS
Jackson River - James River (October - November 1972)

Intolerant or Pollution Sensitive Organisms (to decomposable organic wastes)

Station	1	2	3	4	5	6
Stoneflies						
Brachyptera sp.	1					
Mayflies						
Baetidae	1				5	
Stenonema sp.	9					
Caddisflies					3	
Diplectrona sp.					2	
Hydropsyche sp.		1		x		
Hydroptilidae				x		
Neureclipsis sp.					x	
Nyctiophylax sp.					1	
Psychomyia sp.	7					
Riffle Beetle						1
Heterelmis sp.						
Narpus sp.	2					
Psephenus sp.	1					
Midges						
~~*Brillia* sp.~~						
Psectocladius sp.		1				
Craneflies						
Tipula sp.	1					

TABLE III

Station	1	2	3	4	5	6
Gill Breathing Snail						
Viviparus sp.	1					
SUBTOTAL (per square foot)	23	2	-	-	11	1
SUBTOTAL KINDS (genera)	8	2	-	2	5	1
Facultative or Intermediate Organisms (to decomposable organic wastes)						
Flatworms						
Planaria sp.		2			1	
Scuds						
Gammarus sp.					1	
Hyalella sp.	3					
Smoky Alderfly						
Sialis sp.	1					
Midges						
Chironomidae						
Coelotanypus sp.	1	1				
Crictopus sp.	2	2				
Orthocladius sp.	2					
Polypedilum sp.	1					
Procladius sp.						
Tanypus sp.	2					1
Gill Breathing Snails						
Pleurocerca sp.	1	2				
Air Breathing Snails						
Gyraulus sp.			x			

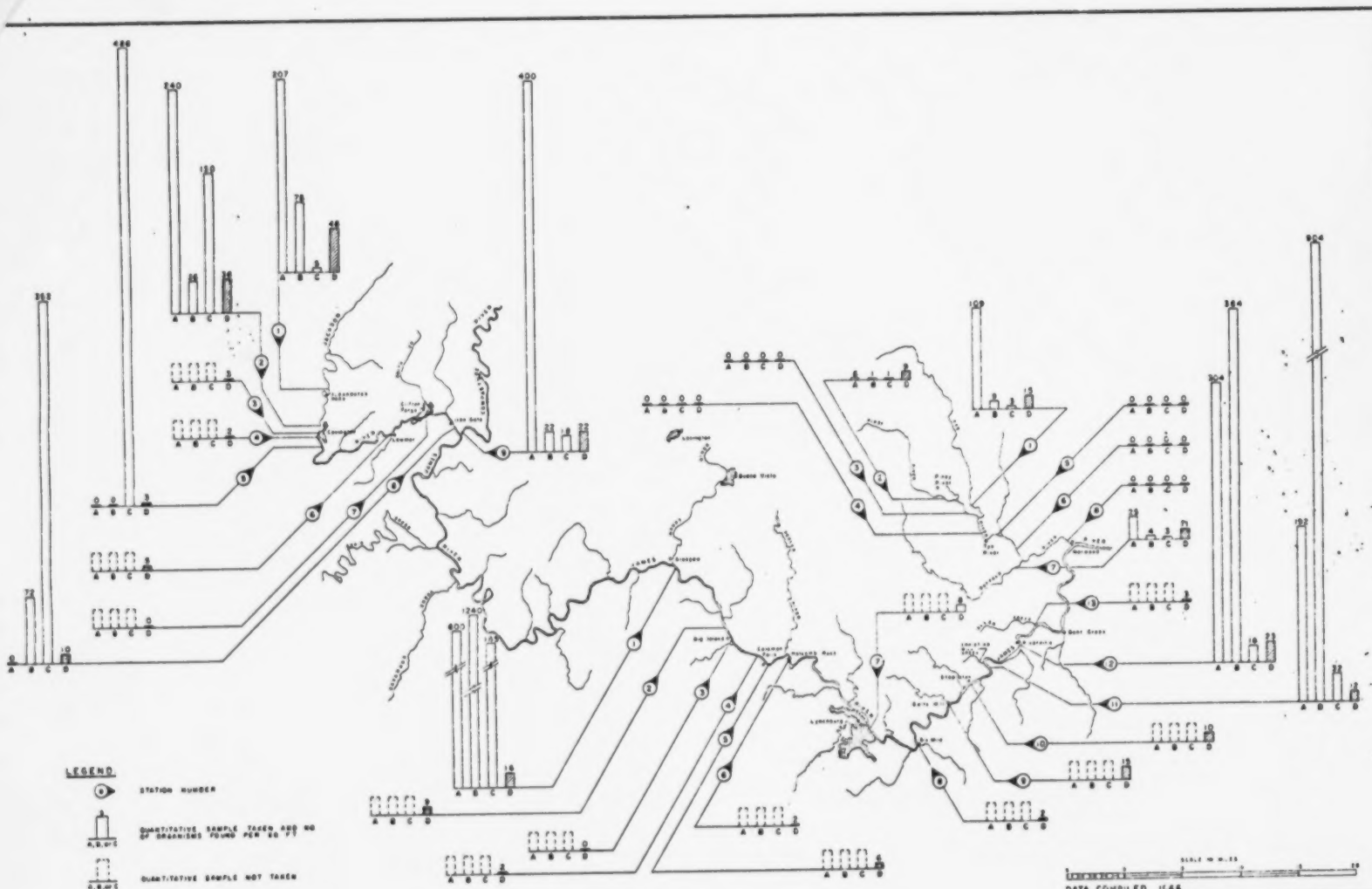
TABLE III

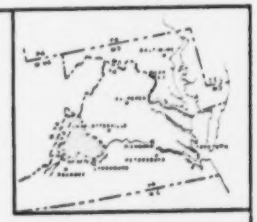
Station	1	2	3	4	5	6
Bristleworm						
Naididae		1				1
Riffle Beetle						
Limnichus sp.						1
Caddisflies						
Cheumatopsyche sp.					4	1
Cyrnellus sp.		1				
SUBTOTAL (per square foot)	13	9	-	-	6	4
SUBTOTAL KINDS (genera)	8	6	1	-	3	4
Pollution Tolerant Organisms (to decomposable organic wastes)						
Air Breathing Snails						
Ferrissia sp.					1	
Physa sp.			x	x		5
Bloodworms						
Chironomus sp.		2				19
Water Scavenger Beetles						
Berosus sp.	1					
Bristleworms						2
Lumbriculidae		1		x	1	
Sludgeworms						
Tubifex sp.		47	x		1	1

TABLE III

Station	1	2	3	4	5	6
SUBTOTAL (per square foot)	1	50	-	-	3	27
SUBTOTAL KINDS (genera)	1	3	2	2	3	4
GRAND TOTAL (per square foot)	37	61	-	-	20	32
NO. OF KINDS	17	11	3	4	11	9

x = Present but not collected in quantitative sample


LEGEND
STATION NUMBER
QUANTITATIVE SAMPLE TAKEN AND NO OF ORGANISMS FOUND PER SQ FT
QUANTITATIVE SAMPLE NOT TAKEN
QUALITATIVE SAMPLE TAKEN AND No. OF KINDS (GENERA) OF ORGANISMS FOUND
BOTTOM ORGANISMS:
A CLEAN WATER ORGANISMS FOUND IN SQ FT SAMPLE
B INTERMEDIATE ORGANISMS FOUND IN SQ FT SAMPLE
C POLLUTION TOLERANT ORGANISMS FOUND IN SQ FT SAMPLE
D TOTAL No OF KINDS, INCLUDING TYPES A, B & C
DATA COMPILED 1966



LOCATION MAP

JAMES RIVER BASIN
CHESAPEAKE DRAINAGE AREA

BIOLOGICAL SURVEY
JAMES RIVER & TRIBUTARIES
(CLEARWATER PARK - NORWOOD, VA.)

U.S. ENVIRONMENTAL PROTECTION AGENCY
MIDDLE ATLANTIC REGION
REGION III PHILADELPHIA, PA.

FIGURE 4